
d.) Remarks

Specification

The application has been amended to correct the following spelling errors: “perfluoralkyl” has been amended to “perfluoroalkyl” in the abstract, and “perfluorether” has been amended to “perfluoroether” in the abstract and on page 4, line 7, and “ration” has been amended to “ratio” in Table 1. A grammatical error in the abstract was also corrected; support for this correction is found in claim 2 as originally filed. The language at page 15, beginning line 1 was clarified. Support can be found in claim 17 as originally filed.

Claim Rejections – 35 USC § 112

Claims 14 and 17 were indicated as rejected because “the specification, while being enabling for perfluoro-1,3-dimethylcyclohexane and C₁₅F₃₃N as the halogen compound that is a flame retardant material” ... “the specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make the invention commensurate in scope with these claims.” It is believed that this rejection was intended to apply to claims 14 and 15.

It is submitted that perfluoro-1,3-dimethylcyclohexane is a suitable halogen-containing compound that represents members of the Markush groups listed in claims 14 and 15, namely, cyclic alkyl and aliphatic heterocyclic compound groups, and that C₁₅F₃₃N is a suitable halogen-containing compound that represents several other members of the Markush groups listed in claims 14 and 15, namely, unbranched alkyl, aminoalkyl, perfluoroalkyl groups, and perfluoroaminoalkyl groups.

To determine whether a particular chemical in the Markush groups will be liquid at room temperature and pressure, substantially immiscible in the electrolyte, and flame retardant, one need only observe some of the chemical at room temperature and pressure, attempt to mix it with the electrolyte, and test it for flame retardancy. One of ordinary skill in the art would know how to determine whether the chemical is a flame retardant material, either by testing safety of a completed battery using the “Overcharge Test” method described on page 18 of the present application, or by using one or more standard tests known in the art. See, for example, Narang et al. column 6, lines 1-20; JP 10-012272, abstract; Arai, abstract; McEwen et al.

US 2002/0110739 A1, paragraphs [0076]-[0077]; EP 1 205 997 A1, paragraphs [0031]-[0035] and [0131]-[0133]; and EP 1 253 662 A1, paragraphs [0039]-[0042], [0048], and [0052]-[0053], each of which has been cited either by the applicant or by the examiner in this case. Another straightforward process for finding combinations of nonaqueous electrolyte solutions and flame retardant materials that satisfy the requirements of the claimed invention is to obtain chemicals known from available data to be flame retardant and liquid at room temperature and pressure, and attempting to mix these chemicals with various possible nonaqueous electrolyte solutions to test for immiscibility. It is submitted that these processes do not constitute undue experimentation to one of ordinary skill in the art. For the above reasons, it is submitted that claims 14 and 15 are enabled. Reconsideration of these claims is respectfully requested.

Claims 10, 17, and 22 were rejected as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 10 has been amended to clarify that the at least one carbonate comprises a carbonate selected from the group consisting of: a cyclic carbonate containing an alkylene group with 2 to 5 carbon atoms and a linear carbonate containing a hydrocarbon group with 1 to 5 carbon atoms. Claim 22 has been amended to clarify that the negative electrode contains a metal oxide selected from the group consisting of: tin oxide and titanium oxide. Support for this change can be found on page 14, lines 3-12. Claim 17 was rejected as depending from the rejected base claim 10, which should now be in condition for allowance. Reconsideration of these claims is respectfully requested.

Claim 13 has been amended to fix a grammatical error.

Claim Rejections – 35 USC § 102

Claims 1-9, 11-15, 20, 21, and 23 were rejected as being anticipated by Narang et al. (US 5,830,600) and as evidenced by Galden PFPE:Heat Transfer Fluids Product Data Sheet for Galden ® HT90 Fluid pp. 1-3 and Data sheet for Ethylene Carbonate obtained from Chemfinder.com. The Office communication states, “The Galden PFPE:Heat Transfer Fluids Product Data Sheet for Galden ® Ht90 Fluid shows that the perfluoropolyether Galden ® HT90 is a fluid that is not substantially miscible with water” (emphasis added). However, in the present invention, the electrolyte solution is non-aqueous, and the flame retardant material is substantially immiscible in the non-aqueous electrolyte solution. That the flame retardant

material is not substantially miscible with water does not indicate that it is not substantially miscible in the non-aqueous electrolyte solution, as required by the claim. It is submitted that the references, alone or in combination, do not teach or suggest an electrolyte system comprising a non-aqueous electrolyte solution and a flame retardant material substantially immiscible with the non-aqueous electrolyte solution, as claims 1-9, 11-15, 20, 21, and 23 are limited.

Claims 1-9, 11-15, 20, 21, and 23 were rejected as being anticipated by JP 10-012272A (JPO Machine Translation). It is submitted that this reference does not teach or suggest an electrolyte system comprising a non-aqueous electrolyte solution and a flame retardant material that is substantially immiscible with the non-aqueous electrolyte solution, as claims 1-9, 11-15, 20, 21, and 23 are limited. In paragraph [0006] of the JPO Machine Translation, the “electrolytic solution is characterized by containing the ** fluorine ether.” If fluorine ether is the flame retardant material and the electrolyte solution contains the fluorine ether, the flame retardant material must not be substantially immiscible in the non-aqueous electrolyte solution because it would not form a solution if it were immiscible.

Furthermore, in claims 5-8 of the present invention, the flame retardant material is present in an amount by weight of the non-aqueous solvent ranging from about 1 to about 99%, about 1 to about 70%, about 10 to about 60%, and about 20 to about 40%, respectively. Paragraph [0030] of the JPO Machine Translation states, “The ** fluorine organic solvent of this (c) component is preferably contained five to 30% of the weight 0.5 to 30% of the weight among nonaqueous electrolyte. When there are few content rates of this (c) component, the improvement effect of nonflammable-izing of a rechargeable battery is inferior. Moreover, if many [conversely], electrical conductivity will fall and a desired cell property will not be discovered.” Because the ** fluorine organic solvent is contained in the electrolyte solution, the quantity of ** fluorine organic solvent is limited to 0.5 to 30% of the weight before electrical conductivity of the electrolyte solution is reduced too much. On the other hand, in the present invention in which the flame retardant is immiscible in the electrolyte solution, although 30% by weight was determined to be adequate for flame retardancy in the examples tested, more could be used without decreasing electrical conductivity of the electrolyte. (See page 4, lines 7-11.) Therefore, the JP 10-012272 reference does not teach these ranges; nor would it have been obvious to modify the reference to use the ranges claimed in the present invention.

Claims 1-9, 11-15, 20, 21, and 23 were rejected as being anticipated by Arai (US 6,210,835 B1). In column 3, lines 47 to 51, Arai states, “The present lithium secondary battery is characterized in that the non-aqueous liquid electrolyte comprises a mixed solution of an ion nonconductive solvent and a lithium ion conductive solvent” (emphasis added). According to column 4, line 4-6, the ion nonconductive solvent is the “non-flammable solvent”. If the non-flammable solvent were substantially immiscible in the lithium ion conductive solvent, they would not form a “mixed solution”. Therefore, it is submitted that this reference does not teach or suggest a flame retardant material that is substantially immiscible in a non-aqueous electrolyte solution, as claims 1-9, 11-15, 20, 21, and 23 are limited:

Reconsideration of these claims is respectfully requested.

Claim Rejections – 35 USC § 103

Claims 17-19 were rejected as being unpatentable over Narang et al. and as evidenced by Galden PFPE and Data sheet for Ethylene Carbonate obtained from Chemfinder.com. The Office communication states that although “Narang et al. disclose all the limitations of claims 17-19” “except filling the battery case at least partially with non-aqueous electrolyte solution, waiting a period of time sufficient for the non-aqueous electrolyte solution to penetrate one or more pores of the electrode assembly and then adding the flame retardant material to the casing, and charging the energy storage device after adding the nonaqueous electrolyte solution”, “it would have been obvious to one of ordinary skill in the art at the time the invention was made to add the nonaqueous electrolyte solution to the casing and wait for a period of time sufficient for the non-aqueous electrolyte solution to penetrate one or more pores of the electrode assembly and then adding the flame retardant material to the casing instead of adding the nonaqueous electrolyte solution containing the flame retardant material to the casing in one step because the courts have held that the selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results”.

It is submitted that in the present invention, new and desirable results are obtained by selecting the order of the steps according to claims 17-19. In the present invention, the flame retardant material does not mix with the electrolyte, so the properties of the electrolyte are not degraded by the flame retardant. There is no intention in the present invention of mixing the electrolyte with the flame retardant to form a solution. By filling the casing at least partially with

the non-aqueous electrolyte solution, waiting a period of time sufficient for the non-aqueous electrolyte solution to penetrate one or more pores of the electrode assembly, and then adding the flame retardant material to the casing, penetration of the electrolyte solution into the electrode assembly can be maximized, with the flame retardant material blanketing the electrolyte-soaked electrode assembly. (See p. 5, line 17 – p. 6, line 3.) On the other hand, Narang et al. teach fire-retardant electrolyte compositions comprising a lithium salt dissolved in a fire-retardant solvent (see abstract). It would be nonobvious to try to add flame retardant solvent of Narang et al. after adding other electrolyte components to the battery case, not only because it would be difficult to adequately mix the components to form the solution of Narang et al., but also because, in contradistinction to the present invention, there is no teaching or motivation to do so.

Regarding claim 18, the Office communication also states that it “would have also been obvious to one of ordinary skill in the art at the time the invention was made to charge the energy storage device” ... “because the charging process is necessary to intercalate the anode with lithium from the cathode prior to using the battery as a portable energy source.” Claim 18 has been amended to clarify that the energy storage device is charged after filling the casing at least partially with the non-aqueous electrolyte solution and before adding the flame retardant material to the casing. As the Office communication pointed out, it would have been obvious to one of ordinary skill in the art to charge the energy storage device after adding the non-aqueous electrolyte solution; therefore, clearly, the intent was to limit the claim to charging prior to adding the flame retardant material to the casing. The specification has also been amended on page 15 to include this language. It is submitted that there is no teaching in any of the references to fill an energy storage device casing with electrolyte solution, then charge the energy storage device, then add flame retardant material to the casing. It is further submitted that it would be nonobvious to modify the reference to change the order of the steps according to the present invention, and that the reference so modified would not result in the present invention. It is submitted that if the flame retardant component of the electrolyte solution of Narang et al. were added after the other components and after charging, the flame retardant component would eventually mix with the other components of the electrolyte solution, which would diminish the function of the solution as an electrolyte.

Furthermore, it is submitted that Narang et al. fails to teach or suggest an electrolyte system comprising a non-aqueous electrolyte solution and a flame retardant material that is

substantially immiscible in the non-aqueous electrolyte solution, as claim 1 is limited, from which claims 17-19 depend. For all these reasons, it is submitted that claims 17-19 are patentable over Narang et al.

Claims 17-19 were rejected as being unpatentable over JP 10-012272 A (JPO Machine Translation) for the same reasons given in the rejection over Narang et al. The rejection is overcome for the same reasons given above.

Claims 17-19 were rejected as being unpatentable over Arai for the same reasons given in the rejection over Narang et al. above. The rejection is overcome for the same reasons given above.

Reconsideration of these claims is respectfully requested.

Allowable Subject Matter

Claim 16 was objected to as being dependent upon a rejected base claim but was indicated as allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. It is submitted that for the reasons given above, claims 1 and 4, from which claim 16 depends, are patentable as originally filed.

Conclusion

Applicant respectfully submits that claims 1-24 are now in condition for allowance and requests that a timely Notice of Allowance be issued.

Respectfully submitted,



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